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PATENT SPECIFICATION

DRAWINGS ATTACHED

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Inventor: THOMAS EDWARD GODDEN

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COMPLETE SPECIFICATION

Improvements in or relating to Electrical Resistance Heating Mats

We, M. H. GODDEN LIMITED, a British Company, of Bouncers Lane, Prestbury, Cheltenham, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electrical resistance heating mats for use in aircraft de-icing systems.

Aircraft de-icing systems have come into use, particularly for airframe control surfaces, of the type (hereinafter referred to as "the foregoing type") in which electrical heaters are used providing a plurality of continuously energised "breaker" strips which break up the ice formation into areas of convenient size. The heaters also provide discontinuously energised areas which are cyclically energised to dislodge the areas of ice one after the other. The invention is concerned with electrical resistance mats for use in such systems.

According to the invention a mat for use in a system of the foregoing type is of woven form, with a plurality of "breaker" strips and also areas of the mat which are discontinuously energised in use each comprising electrical resistance wire woven into a textile fabric sheet as a series of weft threads to form ribbon-like resistance structures of concertina-like form, at least one of the breaker strips extending generally longitudinally of the mat and the remainder extending generally laterally thereof.

The strips and areas are conveniently separately woven in a plurality of separate pieces of base fabric which are subsequently assembled to form the complete mat. They may be assembled and bonded between sheets of neoprene rubber or the like to form a sandwich mat structure. The main structure of the mat preferably comprises glass-fibre yarn, which has desirable thermal and electrical insulating properties. The resistance wire conveniently has its own insulating sheath of polytetrafluoroethylene.

A mat for de-icing the leading edge area of an aircraft control surface has a continuously energised longitudinal breaker strip which extends along the leading edge spanwise, and a plurality of further lateral breaker strips radiating therefrom chordwise above and below the leading edge strip. The leading edge breaker strip and the chordwise breaker strips may be woven as a single ribbon. The discontinuously energised areas are disposed between the chordwise breaker strips on both sides of the leading edge breaker strip. The ribbons forming the heaters for the discontinuously energised areas may span the space between the chordwise breaker strips or a plurality of ribbons may together span said space.

Electrical connections to the ends of the resistance ribbons may be taken out of the mat as flying leads or at a terminal block at suitable points; if necessary the resistance wire may extend back to such points alongside the weft-woven ribbons as warp in the woven structure. This enables suitable electrical termination points to be chosen.

The woven ribbons of the breaker strips, both spanwise and chordwise, preferably extend parallel to the leading edge strip, together with the ribbons of the remaining areas.

A woven electrical resistance mat representing an illustrative embodiment of the invention for the leading edge of an aircraft control surface will now be described by way of example with reference to the accompanying drawings in which:—

Figure 1 shows a perspective view of a mat in position on the control surface, and

Figure 2 shows to a larger scale the layout of the heating wire in the mat.

The mat 1 is of rectangular form with a plurality of woven sections 2 each of which comprise seven ribbons separately woven as weft threads on a main structure of glass-fibre

[*Price 4s. 6d.*]

yarn. Of these seven ribbons, one provides breakerstrips and is woven to form chordwise breaker strips 3 and a spanwise leading edge breaker strip 4, as seen in Figure 2. The chordwise breaker strips 3 span the area to be heated. The remaining six ribbons of each section 2 are divided into two sets of three ribbons 5 and 6 respectively, disposed on each side of the leading edge breaker strip 4, each of the six ribbons being parallel to each other and to the leading edge breaker strip. The ends of each of the seven ribbons are taken to corresponding terminal blocks 7 for connection into the electrical circuit. The terminal blocks 7 are disposed on the inner surface of the skin 8 of the aircraft control surface.

On assembly of the sections 2 to form the complete mat 1, the leading edge breaker strips 4 combine to form a continuous strip along the leading edge of the aircraft control surface and the chordwise breaker strips 3 define areas which are filled by the ribbons 5 and 6. The assembled mat 1 is bonded between a base neoprene layer 9 of 0.020 inch thickness and a top layer 10 of 0.010 inch thickness neoprene. The whole is cured in an autoclave to provide a finished rigid shape of the required dimensions and is then secured to the skin 8 of the aircraft control surface.

During weaving the various ribbons are woven so that in the finished mat they completely cover the full area to be de-iced. Each woven section 2 is then stretched to shape and size on a wooden frame and coated with rubber solution which is dried off and prevents the fabric fraying when subsequently cut around and close to the resistance ribbons. The resultant trimmed sections 2 are semi-stiff and of the correct size for assembly in the described disposition on the neoprene base layer 8 the upper surface of which is first activated by a suitable agent.

The ribbons of each section 2 are of polytetrafluoroethylene insulated resistance wire, and in use the ribbon forming the chordwise breaker strips 3 and the leading edge breaker strip 4 is continuously energised whereas the ribbons 5 and 6 are cyclically energised. Thus, ice formation is confined to the cyclically energised areas and this ice is removed when energisation of the appropriate ribbons 5 and 6 is effected.

WHAT WE CLAIM IS:—

1. A mat of woven form for use in an aircraft de-icing system of the foregoing type, wherein a plurality of "breaker" strips and also areas of the mat which are discontinuously energised in use each comprise electrical resistance wire woven into a textile fabric sheet as a series of weft threads to form ribbon-like resistance structures of concertina-like form, at least one of the breaker strips extending generally longitudinally of the mat and the remainder extending generally laterally thereof.

2. A mat according to claim 1, wherein the mat has only one longitudinal breaker strip form which the remaining breaker strips extend laterally.

3. A mat according to claim 1 or 2, wherein said strips and areas are separately woven in a plurality of separate pieces of base fabric which are subsequently assembled to form the complete mat.

4. A mat according to any of the preceding claims and for use on the leading edge of a control surface, wherein said longitudinal breaker strip is arranged to extend spanwise along the leading edge and a plurality of lateral breaker strips radiate therefrom chordwise both above and below the leading edge strip.

5. A mat according to claims 3 and 4, wherein the leading edge strip and the chordwise strips of each separate piece of base fabric are woven as a single ribbon.

6. A mat according to claim 4 or 5, wherein the spaces between the chordwise breaker strips, which constitute the discontinuously energised areas, are filled by a plurality of heaters woven as separate ribbons.

7. A mat according to claim 6, wherein each of the heaters of the discontinuously energised areas span the space between the two corresponding chordwise breaker strips.

8. A mat according to claim 6 or 7, wherein the ribbons of the breaker strips and of the discontinuously energised areas extend parallel to the leading edge of the mat.

9. A mat according to any of the preceding claims, wherein electrical connections of the ends of the resistance ribbons are taken out of the mat as flying leads.

10. A mat according to any of claims 1 to 8, wherein electrical connections to the ends of the resistance ribbons are taken out of the mat at a terminal block.

11. A mat according to claim 9 or 10, wherein each resistance ribbon extends back to a point alongside the weft-woven ribbons as warp in the woven structure to enable suitable electrical termination points to be chosen.

12. A mat according to any of the preceding claims, which is bonded between sheets of insulating material to form a sandwich mat structure.

13. A mat according to any of the preceding claims, wherein the textile fabric sheet is composed of glass-fibre yarn.

14. A mat according to any of the preceding claims, wherein the electrical heaters comprise resistance wire having an insulating sheath of polytetrafluoroethylene.

15. A woven electrical resistance mat for the leading edge of an aircraft control surface substantially as herein described with reference to the accompanying drawings.

ARTHUR R. DAVIES,
Chartered Patent Agents,
27, Imperial Square,
Cheltenham.
— and —
115, High Holborn,
London, W.C.1,
Agents for the Applicants.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

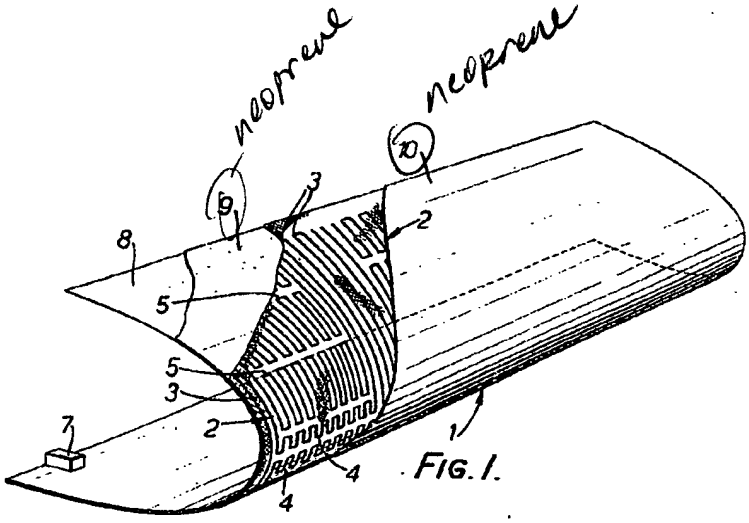

FIG. 1.

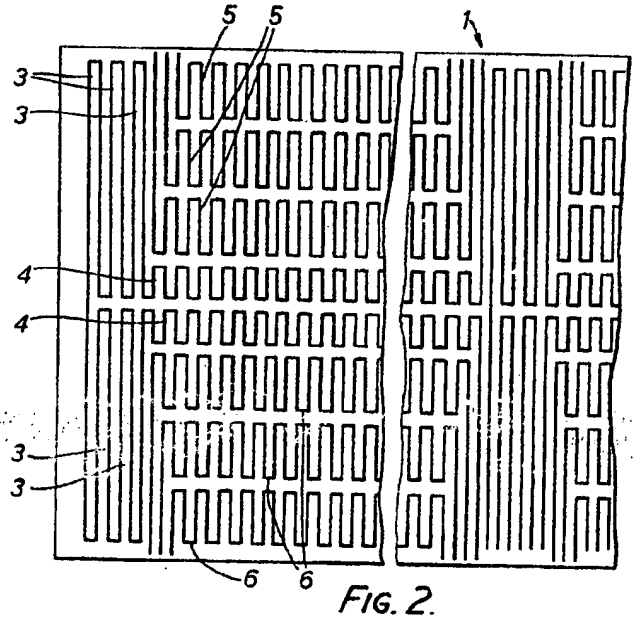

FIG. 2.